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Probing Quantum Dynamics using NISQ Devices: From Ground States to Exotic Symmetries

Friday, 29 August 2025 14:00 (1 hour)

This talk presents methods for simulating both imaginary and real-time dynamics on noisy intermediate-scale quantum (NISQ) hardware to investigate complex physical phenomena.
First, we introduce a quantum circuit-based algorithm for imaginary-time evolution to determine the ground state of 1D infinite-size systems. This approach, based on the time-dependent variational principle (TDVP), is performed via simulations on IBM Q. We critically compare the results of updating the algorithm using an exact state vector versus using statistical data from noisy hardware measurements. Next, we shift to real-time evolution to probe the exotic E8 symmetry in the quantum Ising chain. We implement these dynamics using two distinct methods: direct Trotter decomposition and Riemannian quantum circuit optimization. Our findings show that despite noise and hardware limitations preventing access to the full spectrum, distinct frequency peaks associated with the E8 symmetry can still be clearly observed by preparing different initial states.

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